Box 12-3-1-5

ChemRisk/Shonka Research Associates, Inc., Document Request Form

1660

(This section to be completed by subcontractor requesting document)

Jack Buddenbaum / K-25 Site Records
Requestor / Document Center (is requested to provide the following document)

Date of request 3/22/95 Expected receipt of document 4/7/95

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Title and author (if document is unnumbered)
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~~Peach Folder Oak Ridge~~

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(This section to be completed by ChemRisk/Shonka Research Associates, Inc.)

Date document received

Signature

Safety Dept
Tech. File

K-25 INDUSTRIAL HYGIENE PROGRAM

SCOPE

The Industrial Hygiene Program is concerned with the development, review, and application of all available means for protecting K-25 personnel against any harmful substances, radiations and vibrations which exist or may exist on those portions of the atomic energy project under the operating jurisdiction of the Carbide and Carbon Chemicals Corporation.

ORGANIZATION

The Industrial Hygiene Program consists of the integrated activities of five major groups.

1. The Industrial Hygiene Committee.
2. The Medical Department.
3. The Safety Department.
4. The Industrial Hygiene Section of the Works Laboratory.
5. The Radiation Group.

The Industrial Hygiene Committee is a subcommittee of the Central Safety Committee. It has been delegated the responsibility for determining plant policies in the Industrial Hygiene field and for co-ordinating and exercising general direction over the activities of the Medical Department, the Safety Department, the Industrial Hygiene Section and the Radiation Group in this field. The Medical Department is the source of policy and information on the toxicological and clinical aspects of the Industrial Hygiene Program, the Safety Department is responsible for educational and preventive activities, and the Industrial Hygiene Section gathers data on the nature and extent of existing exposures and supplies this information to the Medical and Safety Departments. The Radiation Group surveys radiation data from various sources and is responsible for recommending radiation protective procedures to the Industrial Hygiene Committee.

Specifically the Industrial Hygiene Committee is responsible for the review and guidance of the following activities:

1. Assembling information on the existence and extent of hazards from harmful substances, radiations and vibrations on the K-25 Plant.
2. Determining the maximum safe exposures to these hazardous materials which are appropriate for general application on the K-25 Plant.
3. Determining and promoting the application of control and preventive measures for the protection of the K-25 personnel.
4. Determining and applying the best medical treatment for exposures to these hazardous materials.
5. Keeping complete records of the nature and extent of the actual and potential exposures to hazardous materials on the K-25 Plant.

Co-ordination of the work of the Medical Department, the Safety Department and the Industrial Hygiene Section of the Works Laboratory is one of the functions of the Industrial Hygiene Committee. This co-ordination, however, has been supplemented in the past by close day-to-day co-operation between these three groups and this close co-operation and free interchange of ideas and information must continue if the Industrial Hygiene Program is to operate effectively.

2. The Medical Department

The Medical Department's functions in the Industrial Hygiene Program are as follows:

a- To interpret data furnished to them by the Industrial Hygiene Section of the Works Laboratory in order to show the nature and extent of existing hazards to personnel.

b- To conduct clinical studies on the industrial hygiene hazards in the K-25 Area and correlate the information thus obtained with the data furnished by the Industrial Hygiene Section.

c- To assemble data on plant industrial hygiene hazards for medico-legal purposes.

d- To furnish toxicological information on the chemical contaminants en-

h- To request chemical contaminant surveys by the Industrial Hygiene Section.

4. The Industrial Hygiene Section of the Works Laboratory

The primary function of this group is to obtain data on the location and concentration of atmospheric contaminants. This data is furnished for the use of the Medical Department, the Safety Department, and the Industrial Hygiene Committee in performing their functions as outlined above. Specifically the Industrial Hygiene Section is responsible for;

a- Special investigations, on request, of potential hazardous locations or operations.

b- Systematic observation of hazardous areas to evaluate the effectiveness of control measures.

c- Routine periodic investigations to obtain statistical data for medical, safety, and legal purposes.

d- Performing specialized analyses for the Medical Department.

e- Determination of the performance characteristics of respiratory protective equipment upon request by the Safety Department.

f- Development of analytical procedures and sampling techniques for atmospheric contaminants.

g- Maintenance and calibration of specialized instruments for analysis of atmospheric contaminants.

h- Overall review of all atmospheric contaminant monitoring operations in the plant.

The services of the Industrial Hygiene Section are originated upon direct request from the Medical and/or Safety Departments and upon their own initiative on general authorization from the Medical and Safety Departments. Data

PLANT HAZARDS COMMITTEE

Minutes -- Meeting, January 27, 1947

The meeting was called to order by the Chairman at 10:00 A. M.

Members present:

Mr. C. N. Rucker, Jr., Chairman
Dr. F. W. Hurd
Dr. H. J. Costello
Mr. L. G. Bamer, Secretary
Mr. A. P. Dunlap
Mr. H. H. Ketcham

Also attending:

Mr. S. C. Barnett
Mr. S. J. Cramer
Mr. E. D. Flickinger
Mr. S. Visner
Mr. J. H. Bull

The called purpose of the meeting was to discuss a proposed series of questions to which Mr. H. H. Ketcham is to seek answers on his trip to the Manhattan District Medical Research Project at Rochester. The proposed series of questions was approved with the addition of two further questions. Under Section B, "Mask Testing," it was decided to insert a third question, "What methods are available for respiratory testing?." Under Section D, "Toxicity," it was decided that question No. 14, "What has been the experience on the project with regard to protection against beta radiation?," should be added. This last question was discussed by Dr. Hurd and Mr. Cramer. Question No. D-10 concerning the alpha radiation from uranium 235 and 234 was discussed. The consensus was that the matter should be carefully looked into. Dr. Hurd and Mr. Cramer discussed the hazard of alpha radiation from deposited uranium.

In general, it was felt that many of the questions could not be answered by the people at Rochester and that every effort should be made to obtain the information from other sources.

Mr. Ketcham was requested to make a thorough survey of all reports from Rochester with the view of extracting from them all possible information on the toxicity of the coded chemicals and protective measures to be used in handling them. Mr. Dunlap stated that the Plant Records Department could assist him in assembling these reports.

Mr. Bamer suggested, and the Committee approved, that the name of the Committee be changed from "Plant Hazards Committee" to "Industrial Hygiene Committee."

Dr. Hurd asked what steps should be taken by the Industrial Hygiene Group of the Works Laboratory when they find hazardous concentrations of toxic materials in locations where men are working without adequate protective equipment. Mr. Rucker said that the endangered workmen's foreman should be notified immediately. Mr. Barnett said that the Area Foreman should be notified in the Process Area. It was understood that a simple form should be established for this notification and that this form would not supersede the present Industrial Hygiene Reports.

At Mr. Bamer's suggestion, it was decided that the topic for the next meeting of the Industrial Hygiene Committee should be the reports of Dr. Cranch and Mr. Stom on their recent surveys of the K-25 Plant.

L. G. Bamer
Secretary

L.G.Bamer
JHB:MSM:BB

INDUSTRIAL HYGIENE COMMITTEE

(Formerly Plant Hazards Committee)

Minutes -- Meeting, February 7, 1947

The meeting was opened by the Chairman at 10:00 A. M.

Members present:

Mr. C. N. Rucker, Jr., Chairman	Mr. L. G. Bamer, Secretary
Dr. M. J. Costello	Mr. S. J. Cromer
Mr. A. P. Dunlap	Mr. N. H. Ketcham

Also attending:

Dr. T. W. Hale, Toxicologist, UCCC	Mr. L. L. Forward
Mr. A. P. Huber	Mr. J. H. Bull

The subject of the meeting was Mr. Ketcham's report on his recent trip to the Medical Research Project at Rochester. Mr. Ketcham presented his own report and those present commented as he went along.

The matter of setting up a canister testing program at K-25 was discussed. Mr. Dunlap questioned the legal advisability of testing our own masks. He suggested that we might bring in an Atomic Energy Commission man to observe and to issue reports on mask testing for the Commission. Dr. Hale said that Union Carbide tests its own masks for special chemical exposures and that those results have been completely acceptable so far. Mr. Ketcham suggested that we investigate the possibility of getting Bureau of Mines approval on the U. S. Army Assault Mask for the exposures encountered in this plant. The consensus was that it would be desirable to set up a mask testing program here. Mr. Ketcham said that he felt that the people at Rochester would go along with such a program.

Mr. Ketcham said that a trip to Pittsburgh to discuss the matter with the Bureau of Mines would be desirable and the rest of the Committee agreed that he should go. He warned that such a mask testing program would be time-consuming and would cover a period of months rather than weeks.

Dr. Hale said that he would contact Capt. George Lyon with regard to information on his experience with PG and the Army Assault Mask at Philadelphia. Dr. Costello will request the summary of project medical experience from Capt. Brundage. Mr. Ketcham was asked to write a letter for Mr. Center's signature to Capt. Brundage requesting information on Capt. Lyon's and Capt. B. S. Wolf's experiences with the U. S. Army Assault Mask. Mr. Dunlap suggested that Mr. Ketcham request declassified documents through the Plant Records Department.

Mr. Bamer suggested that consideration be given to the manner in which canisters are stored even before further information on their storage is available. A discussion of the effect of moisture on the canister followed and Mr. Dunlap asked what would happen in case of fire when fog nozzles are used. Mr. Bamer said that in such cases the oxygen breathing apparatus would be recommended.

It was also agreed that the mask testing program should begin by a determination of the performance characteristics of the canister under simple conditions such as continuous exposure to various concentrations of PG and then proceed to work toward answers to the questions proposed by the January 27 meeting of the Plant Hazards Committee. Eventually, all exposed masks brought to the Dispensary should be tested.

Dr. Costello stated that masks are not being used by persons who cut into converter connections and Mr. Rucker said that this should be looked into. Mr. Huber said that a record is being made of the atmospheric conditions each time the process system is cut into. Atmospheric analyses are made by the Cascade Services Department on a minimum schedule of once every two hours on converter change-out jobs.

Mr. Forward suggested that a notation should be made on Hazardous Work Permits as to what exposure conditions have been encountered on the job. Mr. Ketchem said that this information might funnel through his section to regular Safety and Medical channels. Mr. Cromer said it would probably be desirable for the workmen on the job to make this statement rather than a foreman who might not actually be present.

Mr. Bamer said that improved education of the workmen in the plant would be helpful in assisting them to understand and to protect themselves against such hazards as the fumes in the converter change-out jobs. He said that the Safety Department will develop such a program of education for the Maintenance Division. Mr. Rucker said that Process Supervision should be present at converter change-out jobs and that he will check into this matter.

Mr. Bamer suggested that the use of carbon tetrachloride be eliminated in cleaning operations and that its use be confined, so far as possible, to fire extinguishers. Dr. Nale discussed a fatality from carbon tetrachloride exposure which occurred recently at South Charleston. Mr. Dunlap warned against the hazard of replacing carbon tetrachloride with inflammable solvents. It was agreed that the Safety Department should make a survey of the use of carbon tetrachloride in the plant and report its findings and recommendations to the Industrial Hygiene Committee.

The next subject discussed was the mercury vapor hazard and Mr. Ketchem reported his observations in the Taylor Instrument Company's Plant in Rochester. Mr. Forward said that the mercury vapor hazard in the Instrument Electronic Shop would be reduced in the coming year by the conversion from glass to metal diffusion pumps. Dr. Nale presented Mr. Stam's ventilation recommendation. Mr. Bull said that the mercury vapor hazard in the Instrument Electronic Shop had been reduced during the past year from a very serious one to a point where it is now almost completely under control and that this has been accomplished by improved housekeeping methods. He said that the Safety Department feels that the carrying out of its recommendations on improved housekeeping facilities at the two points where mercury vapor is released would put the mercury vapor problem completely under control and, thereby, make Mr. Stam's excellent recommendation on room ventilation unnecessary. It was agreed that this seemed

the best course in light of the small expense of the changes recommended by the Safety Department and the prospect of a fundamental reduction of the hazard upon changing to metal diffusion pumps.

Dr. Nale said that he did not consider five-minute exposures to three to five milligrams per cubic meter of mercury vapor as presenting any significant hazard if not repeated more often than three or four times a week.

The meeting adjourned at 12:00 noon.

L. G. Bemer
Secretary

L.G.Bemer
JHB:MSH:BB

CARBON & CARBIDE CHEMICALS CORP.
OAK RIDGE, TENN.

SAFETY BULLETIN #14.

DUMPING CARBON TRAPS

14.01 Carbon traps shall be dumped in accordance with the following procedure before any work is started which involves cutting or welding on the trap.

14.02 The dumping of a carbon trap shall not be started until written authorization in the form of a work permit has been executed in accordance with established procedure.

14.03 The room in which a carbon trap is dumped shall be well ventilated, using auxiliary ventilation if necessary.

14.04 Only drums specifically approved for the purpose shall be used to receive carbon.

14.05 A spent carbon trap shall be purged with G-74 before it is dumped. Purging shall be continued until laboratory tests indicate that purging is complete.

14.06 The carbon trap and the drum to which it is dumped shall be made a closed system with a G-74 purge connection.

14.07 U. S. Army Assault Masks, neoprene or neoprene dipped canvas gloves, and coveralls shall be worn by all persons engaged in dumping carbon traps.

14.08 The drums into which carbon is dumped shall be covered tightly as soon as possible after filling.

14.09 The empty carbon trap and connection to drum shall be purged with G-74 before the last drum is disconnected.

14.10 Direct contact with spent carbon and the inside surface of carbon traps shall be avoided.

14.11 Spilled spent carbon shall be shoveled into a container which shall be immediately closed. The dust remaining from a spill shall be cleaned up by means of a Rex-Air vacuum cleaner.

14.12 All protective equipment which has been used in contaminated areas shall be turned in to the Safety Department.

May 11, 1945

CARBIDE & CARBON CHEMICALS CORP.
OAK RIDGE, TENN.

SAFETY BULLETIN #13

EVACUATION PROCEDURE FOR THE CONDITIONING AREA (Furnace Room & Basement)

13.01 The alarm for evacuation of the Conditioning Area, (Furnace Room and Basement) shall be the sound of a siren that is plainly audible throughout the area. (The alarm shall be tested daily and a record made of the tests.) This alarm is sounded by actuating any one of the emergency alarm buttons located at each exit and various other plainly marked points in the area.

13.02 The emergency alarm is to be sounded by any employee believing an emergency exists. The following examples illustrate the sort of condition which may be considered an emergency:

a- Any serious gas leak.
b- Fire caused by the reaction of gas with other materials.
c- Atmospheric conditions indicating a substantial escape of gas, even though the leak has not been located.

13.03 The person who actuates the emergency alarm button shall proceed immediately to the emergency alarm station in the center of the control house and await the arrival of the senior operating supervisor.

13.04 Upon hearing the siren all persons in the Conditioning Area shall walk rapidly to the nearest convenient exit. All persons other than operating employees shall follow the operating employees to the exit, insuring that any visitors or new employees will automatically leave by the nearest exit. In the basement, persons in the "B" furnace area will normally use the exits on the east side of the room. The stairways to the furnace room shall not be used for emergency evacuation.

13.05 After leaving the area, the employees shall proceed to ground floor level and congregate in the area around their exit door. While in this area they shall maintain a clear passage way to the door.

13.06 Employees shall remain at the above location as long as the alarm siren continues to sound unless instructed by supervision to proceed elsewhere. When the alarm siren ceases to sound, it will be safe for them to return to their jobs.

13.07 The emergency alarm siren shall continue to sound until the Conditioning Area is completely free of gas and is safe to enter. It shall be the responsibility of the senior operating supervisor to determine when the area is safe and to give instructions for the alarm to be shut off.

May 29, 1945

CARBIDE & CARBON CHEMICALS CORPORATION
OAK RIDGE, TENN.

SAFETY BULLETIN NO. 11.

OPERATION OF DEGREASING & PICKLING AREA.

11.01 All persons engaged in guiding equipment into or out of tanks shall wear goggles.

11.02 Persons handling surfaces wet with any of the liquids used in cleaning shall wear neoprene gloves.

11.03 Persons adding acid or alkali to the cleaning tanks from carboys or drums shall wear acid goggles, rubber aprons and neoprene gloves.

11.04 Persons adding ammonia to the cleaning tank shall wear a chemical cartridge respirator with GMD cartridge in addition to the protection called for in paragraph (11.03).

11.05 In mixing water and concentrated sulfuric acid, the acid shall be added to the water, never the water to the acid.

11.06 Material shall be lowered into and removed from the cleaning tank slowly to avoid splashing.

11.07 Hot trichlorethylene shall not be sprayed on equipment unless such equipment is below vapor line.

11.08 Material being removed from a cleaning tank shall be suspended over the tank until drainage is no more than dropwise. In the case of removal from degreaser, equipment shall be suspended for one minute above the vapor line and below the draft line.

11.09 Piping shall be so suspended in slings that drainage will be complete and no liquid will be trapped.

11.10 All acid or alkali equipment shall be drained of its contents and thoroughly flushed with water before any work on it is begun.

11.11 Rubber, neoprene, or rubber or neoprene covered gloves and acid goggles shall always be worn by persons breaking connections on acid or alkali equipment.

11.12 Prolonged breathing of trichlorethylene vapors shall be avoided. A chemical cartridge respirator with GMC cartridge shall be worn in locations where bad spills occur, until atmosphere is cleared.

11.13 Persons in the vicinity of trichlorethylene operations shall not smoke.

SAFETY BULLETIN NO. 11. (cont'd)

OPERATION OF DEGREASING & PICKLING AREA.

11.14 No one shall enter the degreaser unless it has been drained, ventilated until free of solvent vapors and declared safe for entry by the ranking supervisor.

11.15 The degreaser pit shall not be entered until ventilation equipment has been checked and found to be in operation.

11.16 Compressed air hose must not be directed at personnel.

April 26, 1945

CARBIDE & CARBON CHEMICALS CORPORATION
OAK RIDGE, TENN.

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SAFETY BULLETIN NO. 10.

HANDLING OF CONTAMINATED EQUIPMENT (Except Converters).

10.01 The amount and location of process material within equipment to be cut into or otherwise removed from service shall be determined insofar as possible.

10.02 Equipment removed from service shall be effectively sealed against spillage of material contained therein.

10.03 Contaminated outer surfaces of equipment shall be cleaned as well as possible by means of a Rex Air vacuum cleaner. (This procedure shall be used for Case I operations only).

10.04 Disposition of contaminated equipment should be arranged by calling 8601.

10.05 Persons engaged in the handling of vacuum cleaners or contaminated equipment shall wear neoprene gloves as a minimum of protection. Further protection will depend upon the degree of exposure. Protection against contact between any parts of the body or clothing and contaminated equipment shall be provided by rubber boots, aprons, etc., as conditions dictate. If any amount of loose dust is present on the outside of equipment, a Clearvue Dustfoe #2147 respirator with #2148 cartridge shall be worn. If any vapors are evolved the U. S. Army Assault Mask shall be worn.

10.06 Used protective equipment shall be turned in to the Safety Department.

April 26, 1945

RESTRICTED

CARBIDE & CARBON CHEMICALS CORPORATION
OAK RIDGE, TENN.

SAFETY BULLETIN NO. 9.

CLEANUP AFTER MINOR LEAKS.

In the event of a release of process material to the atmosphere the procedure outlined in the appropriate Safety Bulletin shall be followed until the building foreman determines that the magnitude is insufficient to necessitate the precautions required by such bulletin. In such a case the procedure given below shall be followed. In case of a release in a withdrawal alley or other location not specifically covered by Safety Bulletin, the affected area shall be evacuated of personnel and roped off or otherwise effectively isolated and the following procedure used:

9.01 Ventilating equipment shall be turned on. If release is in a confined area, auxiliary ventilation shall be supplied if necessary.

9.02 Persons shall re-enter the area only to carry out instructions of the foreman and each person so returning shall wear gauntlet neoprene gloves and U. S. Army Assault Mask until the atmosphere has been declared clear by the building foreman.

9.03 Material remaining on floors, walls or surfaces of equipment shall be removed either by means of a Rex Air Vacuum cleaner, or by scrubbing of surfaces with solution of 2-3% soda ash in water, followed by a water rinse. (The treatment given a bove shall be used only for Case I operations).

9.04 Spills involving vacuum pump oil require the use of still foreshots as a solvent.

9.05 All washings and collected material shall be retained in containers provided for the purpose. Still foreshots and water solutions shall be retained in separate containers. Their disposition may be arranged by calling 8601.

9.06 Persons engaged in the cleanup work shall wear neoprene gloves and a Clearvue Dustfoe #2147 respirator with #2148 filter. If appreciable amounts of vapors are evolved, the U. S. Army Assault Mask shall be worn.

9.07 Used protective equipment shall be turned in to the Safety Department.

April 26, 1945

CARBIDE AND CARBON CHEMICALS CORPORATION

OAK RIDGE, TENN.

SAFETY BULLETIN NO. 8.

SERVICING COLD TRAPS AT LINE RECORDER STATIONS

8.01. Persons servicing line recorder cold traps shall wear safety spectacles and gauntlet neoprene dipped gloves. The gauntlet of the gloves shall be closed by means of a rubber band or other simple means of preventing entry of cold materials into the glove.

8.02. CO_2 snow shall be handled with a scoop and not with the hands.

8.03. Persons servicing line recorder cold traps shall work at arm's length from all cold materials and shall avoid spilling or splashing as far as possible.

8.04. Breathing of trichlorethylene fumes shall be avoided and vessels containing it shall be kept as tightly covered as possible.

4-12-45

CARBIDE AND CARBON CHEMICALS CORPORATION
OAK RIDGE, TENN.

SAFETY BULLETIN NO. 7

OPERATION OF WASTE AND SURGE SYSTEM

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7.01. A face shield shall be worn by each person entering the tails accumulator room, J-609 pump room, C-603 condenser room, or shipping drum room. In addition, gauntlet neoprene or canvas gloves shall be worn by persons handling unprotected process valves, lines or equipment in these rooms. A person sampling process material in the tails accumulator room shall also carry a U. S. Army Assault Mask attached to his person.

7.02. Persons sampling process material in other than the above rooms, shall wear a face shield and gauntlet neoprene or canvas gloves.

7.03. Condenser cubicle door shall be kept closed, except as needed.

7.04. Entry into the cell room and pipe gallery room should be kept to a minimum and entry into the high pressure area shall be limited strictly to persons whose job requires them to enter.

7.05. The ventilator fan in the condenser cubicle shall be kept running at all times except in the event of contamination. (See paragraph 7.07 below)

7.06. In the event of a leak to the room atmosphere in any portion of the building, each person in the affected area shall don his mask, if so equipped, and leave the area immediately by the nearest exit.

7.07. Immediately upon evacuation of personnel from the affected section of the building, all doors and windows in that section shall be closed, and the ventilation for that section shut off.

7.08. Persons shall return to the room only to carry out instructions of the foreman and each person so returning shall wear the protective equipment specified in paragraph 7.12, except that a U. S. Army Assault Mask shall be substituted for the Dustfoe Respirator.

7.09. After a settling period of about a half hour to an hour, the ventilating fans shall be turned on. In the case of the shipping drum room, auxiliary ventilating equipment, supplied by the Safety Department, shall be used. After the atmosphere has been cleared, persons wearing the protective equipment specified in Paragraph 7.12, shall enter the room for inspection.

7.10. Maintenance work shall be deferred until any necessary decontamination as described in Paragraph 7.11, has been carried out.

7.11. If any dust has settled out on the floor, walls, or equipment, it shall be removed by the mimimum number of men consistent with efficient operations. One man equipped with the protection described in Paragraph 7.12 shall remain outside as a precautionary measure. Dust shall be removed by means of an approved type vacuum cleaner. Such decontamination shall be carried out as rapidly as possible.

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7.12. Persons engaged in the removal of dust shall wear: (1) gauntlet type neoprene gloves, (2) Clearvue Dustfoe Respirator (BM 2147 with BM 2148 dust filter), (3) head covering, (4) Rubber Boots, (5) Special coveralls with legs outside boots and tightly fastened at the bottom.

7.13. Eating in other than the control room and switch gear room is prohibited and chewing tobacco, candy, chewing gum, lunches, etc., shall not be carried into other than these rooms.

7.14. All clothing and protective equipment which has been worn in contaminated areas shall be turned over to the Safety Department.

CARBIDE AND CARBON CHEMICALS CORPORATION
OAK RIDGE, TENN.

SAFETY BULLETIN NO. 6

OPERATION OF FEED PURIFICATION SYSTEM.

6.01. Each member of the regular operating crew, and each other person whose duties regularly require entry to the furnace room or still room shall carry attached to his person when entering such rooms, a U. S. Army Assault Mask.

Each person, other than those covered by the above paragraph, shall carry attached to his person, when entering either of the above rooms, an "All Service" mask equipped with model "S" cannister.

A person entering the area between the furnaces and south wall of the furnace room, while any furnace is charged and under heat, shall wear his mask properly adjusted on the face.

6.02. No more drums than one complete furnace charge in addition to the drums in furnaces shall be brought to Building K-101.

6.03. All cylinders shall be checked for evidence of leakage before being placed in electric furnace. Except in case of minor leaks through valve seats, cylinders showing such evidence shall be removed from the building.

6.04. Valve protector caps shall not be removed until the drums are on the carriage.

6.05. Persons engaged in connecting or disconnecting cylinders shall wear neoprene or canvas gloves.

6.06. When the pressure of the drums reaches 10 p.s.i.g., the furnace atmosphere shall be inspected, by means of a light held at one of the sightholes, for leakage. If any evidence of leakage exists the heat shall be turned off, the furnace permitted to cool, and the offending drum removed from the furnace.

6.07. Except as covered by paragraph 6.01, the sampling of process material shall be carried out by persons wearing gauntlet neoprene gloves and face shields.

6.08. Equipment shall be monitored at regular intervals. Where the reading is above the established maximum, the area shall be roped off.

6.09. In the event of a leak to the room atmosphere in any portion of the building, each person in the affected section shall immediately don his mask and leave the building by the nearest exit.

6.10. Immediately upon evacuation of personnel from the affected section of the building, all doors and windows in that section shall be closed, if feasible and the ventilation for that section shut off.

6.11. Persons shall return to the room only to carry out instructions of the foreman and each person so returning shall wear the protective equipment specified in paragraph 6.15, except that a U. S. Army Assault Mask shall be substituted for the Dustface Respirator.

6.12. After a settling period of about a half hour to an hour, the ventilating fans shall be turned on. After the atmoshpere has cleared, persons wearing the protective equipment specified in paragraph 6.15 shall enter the room for inspection.

6.13. Maintenance work shall be deferred until any necessary decontamination, as described in paragraph 6.14, has been carried out.

6.14. If any dust has settled out on the floor, walls, or equipment, it shall be removed by the minimum number of men consistent with efficient operations, but a minimum of two persons shall always be present in the room, and one outside as a precautionary measure. Dust shall be removed by means of an approved type vacuum cleaner. Such decontamination shall be carried out as rapidly as possible.

6.15. Persons engaged in the removal of dust shall wear: (1) Gauntlet type neoprene gloves, (2) Clearvue Dustfoe Respirator (BM 2147 with BM 2148 dust filter), (3) head covering, (4) Rubber boots, and (5) special coveralls with legs outside of boots and tightly fastened at the bottom.

6.16. Eating in other than the control room is prohibited. Chewing tobacco, candy, chewing gum, lunches, etc., shall not be carried into other than control room.

6.17. All clothing and protective equipment which has been worn in contaminated areas shall be turned over to the Safety Department.

CARBIDE AND CARBON CHEMICALS CORPORATION
OAK RIDGE, TENN.

SAFETY BULLETIN NO. 5.

OPERATION OF SERVICE AND PURGE AND PRODUCT ROOMS.

5.01. All non-essential personnel shall be kept out of Service and Purge and Product rooms.

5.02. Persons engaged in the manipulation of any valve shall wear neoprene or canvas gloves.

5.03. The orifice by-pass in the refrigerant line shall not be opened while the cold trap is above -25°F.

5.04. Before disconnecting any portion of the process system, the section of line to be broken shall be evacuated and purged. The section to be broken should be isolated by two valves, preferably with a purge seal between.

5.05. Neoprene or canvas gloves shall be worn by those breaking connections or handling equipment, the exposed surfaces of which may be contaminated with process material.

5.06. Storage and product drums shall be handled with extreme caution, taking care that they do not bump against other equipment. One product shipping cylinder shall be filled and removed from the pit before another product shipping cylinder is filled.

5.07. Each member of the regular operating crew, and each other person whose duties regularly require entry to the Service or Purge and Product room, shall wear attached to his person, when entering such rooms, a U. S. Army Assault Mask.

Each person, other than personnel covered by the above paragraph, shall wear attached to his person, when entering the Service or Purge and Product room, an "All Service" mask equipped with model "S" cannister.

5.08. In the event of a leak, each person in the Service or Purge and Product room shall immediately don his mask and leave the room by the nearest exit.

5.09. Immediately upon evacuation of personnel from room, the doors and wall louvers shall be closed and the ventilating fans shut down.

5.10. Persons shall return to room only to carry out instructions of the foreman, and each person so returning shall wear the protective equipment specified in paragraph 5.14, except that a self contained oxygen breathing unit shall be substituted for the Dustfoe Respirator.

5.11. After a settling period of about a half hour to an hour, the ventilating fans shall be turned on and the wall louvers put back on automatic operation. After the atmosphere has cleared, persons wearing the protective equipment specified in paragraph 5.14 shall enter the room for inspection.

5.12. Maintenance work shall be deferred until any necessary decontamination of room, as described in paragraph 5.13, has been carried out.

5.13. If any dust has settled out on floor, walls, or equipment, it shall be removed by the minimum number of men consistent with efficient operation, but a minimum of two persons shall always be present in the room, and one outside as precautionary measure. Dust shall be removed by means of an approved type vacuum cleaner. Such decontamination shall be carried out as rapidly as possible.

5.14. Persons engaged in the removal of dust shall wear: (1) Gauntlet type neoprene gloves, (2) Clearvue Dustfoe Respirators (BM 2147 with BM-2148 dust filter), (3) head covering, (4) rubber boots, and (5) special coveralls with legs outside of boots, and tightly fastened at bottom.

5.15. Eating in Service rooms and Purge and Product Rooms is prohibited. Chewing tobacco, candy, chewing gum, lunches, etc., shall not be carried into Service or Purge and Product Rooms.

5.16. All clothing and protective equipment which has been worn in contaminated areas shall be turned over to the Safety Department.

CARBIDE AND CARBON CHEMICALS CORPORATION
OAK RIDGE, TENNESSEE

SAFETY BULLETIN NO. 4

EMERGENCY EVACUATION OF PERSONNEL DURING FLASH CONDITIONING CHARGING AND EVACUATION OF CELLS

The following procedure will be used to evacuate personnel in the event an emergency should arise during the preliminary operation of cells.

4.01. EMERGENCY ALARM - The supervisor in charge of the operations shall appoint one person and an alternate to sound the evacuation alarm in the event of any emergency that, in the opinion of the supervisor, necessitates evacuation of personnel. The alarm shall consist of an approved signalling device of distinctive tone and of sufficient volume, the controls of which shall be so located as to be readily accessible at the point of emergency egress.

4.02. EVACUATION OF PERSONNEL - When the alarm is sounded, all persons located within the probable area of contamination shall leave immediately by means of the nearest exit.

4.03. RESCUE WORK - The operating supervisor in charge of operations will appoint two persons to reenter the area after evacuation to determine whether or not injuries have resulted and, if so, to remove the injured through the nearest exit. Persons carrying out rescue work will wear "All Service" Mask (with Model "S" cannister) and will remain together while work is being carried out.

4.04. AMBULANCE SERVICE - If injuries are suffered during an emergency, the members of the rescue squad will be responsible for telephoning 8378, requesting ambulance to convey injured persons to the Carbide Infirmary. First Aid attendants should not enter the operating area to remove injured personnel, except under direction of supervisor in charge of operations.

4.05. GUARD SERVICE - If and when the emergency alarm is sounded the guards on duty will prohibit entrance to the contaminated area of all personnel except the rescue squad and whatever other personnel may be designated by the supervisor in charge of operations.

4.06. SAFETY DEPARTMENT - The Carbide Safety Department will see that the emergency equipment called for by this procedure is available in the proper location upon notification by the operating department of the impending start of an operation.

4.07. THE ALL CLEAR SIGNAL - The supervisor in charge of operations will appoint messengers who will, upon instruction, verbally notify evacuated personnel of the all clear.

February 17, 1945

CARBIDE AND CARBON CHEMICALS CORPORATION
OAK RIDGE, TENN.

RESTRICTED

SAFETY BULLETIN NO. 3.

FLASH CONDITIONING, CHARGING AND EVACUATION OF CELLS.

FLASH CONDITIONING.

3.01 Before the portable cylinder is removed from Building K-1303, it shall be tested for leaks by means of an ammonia bottle. Cylinders with both valves leaking shall not be transported to the Process Area. If only one valve leaks, such valve shall be tagged accordingly.

3.02 All persons opening and closing valves or otherwise handling mobile equipment shall exercise all possible precautions, taking care to keep themselves at arm's length whenever possible. In operating the Keroteet valve on the cylinder, the operator shall stand out of line of any possible discharge from the valve.

3.03 Persons engaged in the connection of the portable cylinder, subsequent valve manipulation, and the disconnection of the cylinder, shall be equipped with long gauntlet asbestos gloves and face shields.

3.04 In the event of a leak of such magnitude that the equipment cannot be handled for removal from the building with the protective equipment provided, the general alarm shall be sounded and the area cleared until such a time as it can be safely re-entered, as determined by the ranking supervisor.

The "All Service" mask provided, rather than face shield, shall be worn if conditions indicate its need.

CHARGING AND EVACUATION - PROCESS MATERIAL

3.05 Extreme care shall be used in connecting the charging cylinder to the assembly. Gauntlet neoprene gloves shall be worn by those performing this operation.

3.06 The valve on the charging cylinder shall be opened slowly and carefully. Gauntlet neoprene gloves shall be worn by those engaged in this and any subsequent manipulation of valves on equipment under positive gage pressure.

3.07 In the event of a leak at the cylinder valve, it shall be stopped immediately, if possible, by closing the valve, and the temperature of the water bath shall be repidly reduced.

3.08 In the event that unforseen positive pressures are encountered, the relief valve by-pass to the carbon trap shall be opened. If a leak occurs, resulting in a discharge to the working atmosphere, the necessary valves shall be closed immediately. Persons engaged in such operations shall wear the "All Service" mask provided if its need is indicated.

3.09 In the event that a discharge to the atmosphere is of such magnitude or nature, or in such a location that it cannot be immediately stopped, the water bath temperature shall be reduced as rapidly as possible. The general alarm shall be sounded, and the area cleared until such time as it can be safely re-entered as determined by the ranking supervisor.

RESTRICTED

(a) The "All Service" mask provided, rather than face shield, shall be worn if conditions indicate its need.

3.10 Carbon trap temperatures shall not be permitted to exceed 450° F., and material leaving the traps shall not be permitted to exceed 200° F. In case either of these limits is exceeded, the flow of material to the carbon traps shall be decreased, an investigation of cause made, and steps taken to eliminate the difficulty.

3.11 Before disconnecting any portion of the unit, all lines and equipment (except the charging cylinder) shall be purged to the stack.

GENERAL

3.12 Persons not actually engaged in the handling of equipment shall keep away from such equipment, unless their duties necessitate their presence close by. The area in the immediate vicinity of the operation shall be enclosed by a rope fence, bearing necessary warning signs.

3.13 The persons in charge shall be on the cell floor at such times as valves on the charging unit are being handled, and shall be alert to all possible emergencies.

3.14 All non-essential personnel shall be kept out of building and adjacent withdrawal alley during the operation.

3.15All equipment, tools, etc., which may have been contaminated shall be thoroughly washed with sodium carbonate solution followed by tap water before re-use.

3.16 Spare protective equipment shall be readily available. Emergency equipment shall consist of two "All Service" masks equipped with model "S" cannisters, at each of the following locations:

(1) Front end of withdrawal alley adjacent to cell.
(2) Rear end of Motor alley adjacent to cell.

Two Underwriters' approved electric lanterns shall be kept adjacent to the mobile equipment, and one at each of the above mentioned locations.

3.17 All exit doors from buildings involved shall be kept unlocked and free of all obstructions.

3.18 The openings in the withdrawal alley curb, connecting the withdrawal alley with the basement, shall be kept closed in the immediate vicinity of the operation.

3.19 In the event that the alarm for personnel evacuation is sounded, the following procedure shall immediately be carried out:

(1) SHUT DOWN ALL VENTILATING FANS, and then, as rapidly as conditions permit.
(2) Close all remaining transoms from withdrawal alley to basement.
(3) Close all louvered grilles in operating floor.
(4) Close all louvers in ventilators directly over escape alley and open dampers in same to roof.
(5) Open dampers to roof in ventilators directly over withdrawal alley.
(6) Open dampers in ventilators from operating floor ceiling.
(7) Restart ambient air fans, leaving center row of fans off.

CARBIDE AND CARBON CHEMICALS CORPORATION
POST OFFICE BOX P
OAK RIDGE, TENN.

SAFETY BULLETIN NO. 3.

REMOVAL OF STAGE PUMPS AND OTHER EQUIPMENT (EXCEPT CONVERTERS AND COLD TRAP EQUIPMENT) IN 300 SECTION.

Products of contamination found within the system are apt to be toxic and the precautions, as set forth below, must be followed:

2.01. Maintenance work shall not be started until written approval, in the form of a Hazardous Work Permit, has been completed.

2.02. The number of men engaged in the removal of equipment should be kept at a minimum.

2.03. In the removal of equipment, the movement of all exposed parts shall be accomplished with as little physical contact and as little exposure to personnel as possible.

2.04. Immediately after the removal of exposed equipment, same shall be covered or blanked.

2.05. During the actual opening of the system, each person so engaged shall wear neoprene gloves and a BM 2101 Respirator with BM 2133 Cartridge.

2.06. "All Service" Masks with Model "S" type cannisters shall be available and shall be worn if there is evidence of restricted breathing.

2.07. Tools used in the removal of exposed equipment shall be thoroughly washed in a sodium carbonate solution followed by rinsing in tap water.

February 13, 1945

CARBIDE AND CARBON CHEMICALS CORPORATION
OAK RIDGE, TENN.

SAFETY BULLETIN NO. 1 (REVISION NO. 1)

CYLINDER STORAGE AND HANDLING

The following does not apply to cylinders of heads material:

1.01 As few persons as is consistent with efficient operations shall be assigned to the handling of cylinders and these persons shall be thoroughly trained and fully competent in the operations involved.

1.02 All feed cylinders shall be stored in warehouses K-1025-A,-B,-C,-D, and -E.

1.03 Tailings cylinders stored out-of-doors shall all be in one isolated and well marked location where access to them shall be limited strictly to the personnel required to handle and inspect the cylinders.

1.04 Cylinders shall be handled and stored in such a manner that the danger of mechanical damage to the valves or the cylinders themselves will be held to a minimum.

1.05 All cylinders shall be thoroughly inspected for evidence of leakage before they are transferred to storage. Loosened safety caps shall be tightened. The presence of a white deposit will indicate the existence of leaks. Leaking cylinders shall be repaired before they are sent to storage.

1.06 Cylinders that develop leaks while in storage shall be removed as soon as they are discovered. The contaminated area shall be isolated until the air has been cleared by ventilation and it has been decontaminated.

1.07 Leaks shall be repaired as follows:

Tighten the leaking part. If this is not effective, the cylinder shall be thoroughly refrigerated before other methods of repair such as tinning, valve replacement, or plugging are attempted.

1.08 Only persons specifically trained in that operation shall attempt the repair of leaking cylinders.

1.09 Tools used in repairing a leak shall be washed with 3% soda ash solution and rinsed with clear water after use.

1.10 Contaminated cylinders, equipment, and areas shall be cleaned up by a specially trained decontamination squad. The services of this squad can be obtained by calling 89681 - 176 at any time, day or night.

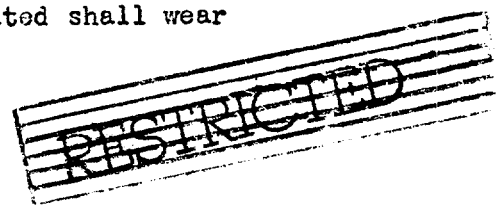
1.11 Protective equipment shall be worn as follows:

A. Persons handling contaminated cylinders or equipment shall wear

Neoprene gloves
Protective coveralls
U. S. Army Assault Mask if vapors are present.

B. Persons entering area where there is an active leak or where the atmosphere is heavily contaminated shall wear

Gauntlet neoprene gloves
Rubber boots
Protective coveralls
U. S. Army Assault Mask.

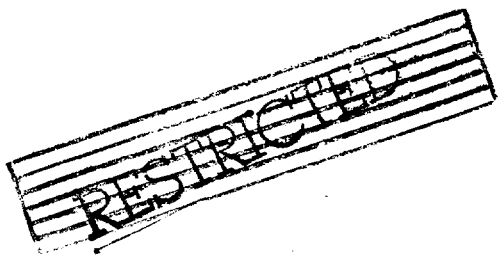


C. Persons entering any area where the air is not clear and odorless shall wear the U. S. Army Assault Mask.

1.12 All contaminated clothing and protective equipment shall be cleaned under controlled conditions before being used again.

1.13 Eating in storage buildings is prohibited. Chewing gum, candy, chewing tobacco, etc., shall not be carried into contaminated areas.

July 13, 1945



CARBIDE AND CARBON CHEMICALS CORP.
OAK RIDGE, TENN.

SAFETY BULLETIN S-8.

C-714

PROPERTIES

Color	-	water-white.
Odor	-	faint characteristic odor.
Specific gravity	-	approx. 2.0
Boiling point	-	104° to 212° F. boiling range.
Solubility:		
Water	-	insoluble
Freon 113	-	soluble to small extent
Halogenated solvents	-	very slightly soluble
Solvent action:		
Fats	-	slightly soluble
C-616	-	soluble
C-2144	-	soluble

C-714 is the low-boiling fraction separated from C-816 in the purification process. It is a mixture of fluorocarbons.

USE

C-714 is used as a solvent in cleaning operations involving C-2144 and MFL.

HAZARDS

Since there is no clinical evidence on which to base statements as to the hazards of C-714, the following information is based on its chemical composition.

1. The toxicity of C-714 vapor is not known but it is presumed to be more irritating than C-816. Concentrations higher than 1000 p.p.m. will cause lung irritation.

2. Prolonged or repeated exposure of the skin to C-714 will cause irritation and dermatitis.

3. C-714 when heated to the temperatures involved in welding, cutting or soldering operations, decomposes to form HF and other highly toxic gaseous products.

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PRECAUTIONS

1. Cleaning operations involving the use of C-714 in open containers shall take place only in well ventilated locations and auxiliary exhaust ventilation shall be used to move the vapors away from persons engaged in such operations.

2. Lines or equipment that have been wet with C-714 shall be drained and blown dry before any welding or cutting is done.

3. Protective equipment shall be worn as follows:

   A. U. S. Army Assault Mask for exposure to high concentrations of C-714 vapor. (Mask will give protection for thirty minutes under these conditions).

   B. Gauntlet neoprene gloves for handling C-714 in open containers.

   C. Goggles for cleaning operations involving use of C-714, where U. S. Army Assault Mask is not worn.

4. Contaminated clothing and protective equipment shall be cleaned under controlled conditions before being used again.

July 2, 1945

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OAK RIDGE, TENN.

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NO. 45 OF 75 COPIES, SERIES A

SAFETY BULLETIN S-7.

MFL

PROPERTIES

Color	-	water-white when pure. gray-green after exposure to C-616.
Odor	-	odorless when pure.
Viscosity	-	16-25 centipoises @ 212° F. pours readily at room temperature.
Molecular weight	-	850 to 900
Density	-	16.2 lbs. per gallon.
Specific gravity	-	1.95
Boiling point	-	very high
Vapor pressure	-	less than $8x10^{-3}$ mm. @ 140° F.
Solubility:		
C-714	-	soluble
Freon 113	-	soluble
C-816	-	soluble
C-716	-	soluble
Water	-	insoluble
Trichlorethylene	-	very slightly soluble
Solvent action:		
C-616	-	C-616 is very soluble in MFL. The solution has a high vapor pressure of C-616. (See Safety Bulletin S-1 for solubility table).
C-216	-	C-216 is very slightly soluble in MFL.

CLASSIFICATION CANCELLED
DATE 5-8-63
For The Atomic Energy Commission
H. R. Carroll
Chief, Declassification Branch

CLASSIFICATION CHANGED TO Confidential
By authority of AEC on 12/3/54
By Marshall Date 1/28/55

This document contains information affecting the national defense of the United States within the meaning of the Espionage Act, 50 U.S.C. 31 and 32. Its transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law.

MFL is a polymerized fluorocarbon compound with the formula $(CF_2-CFCl)_x$. It contains 30% Cl, but has been specially stabilized to C-616 and C-216. It is practically non-reactive with C-616 under operating conditions and is satisfactorily resistant to C-216 in concentrations less than 20% at operating temperatures. Higher concentrations of C-216, however, will react to form polymerized products and 30% C-216 will ignite MFL at elevated temperatures. Explosive mixtures can be formed with MFL mist.

MFL, as received, contains a small amount of dissolved HF.

This document has been approved for release to the public by: [signature] 6/23/95 Date
Technical Information Officer
Oak Ridge K-25 Site

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MFL is presently used as a vacuum pump oil in Beach-Russ pumps in the purge and product and cold trap rooms, in the Stokes pumps on portable C-616 units, and experimentally in some of the Valley Iron Works pumps.

HAZARDS

1. The chief hazard in handling MFL results from the fact that it dissolves C-616 and the solution, when hot, has a high C-616 vapor pressure. MFL that has been exposed to C-616 will give off strong fumes and since the dissolved C-616 is protected from hydrolysis by MFL, it will continue to fume for long periods of time. These fumes present the same hazard as the escape of C-616 from process lines or equipment.

2. C-616 dissolved in MFL has the same corrosive action on the skin that C-616 or its hydrolysis products would have by themselves. Burns resulting from contact with contaminated MFL are likely to be severe because the sticky, fluid consistency of MFL tends to give intimate contact with the skin and its insolubility in water makes its removal difficult.

3. MFL, when heated in air to the temperatures involved in welding, cutting or soldering, decomposes to form HF and other very toxic gaseous products.

PRECAUTIONS

1. As far as possible, MFL that has been exposed to C-616 should be handled in a closed system.

2. Exposure to MFL shall be avoided.

3. Protective equipment shall be used as follows:

   A. U. S. Army Assault Mask for:

      a - Opening equipment that contains MFL which has been exposed to C-616 or C-216.

      b - Welding, cutting or soldering lines or equipment that have contained MFL.

   B. Neoprene gloves for:

      a - Handling MFL in open containers.

   C. Face shields for:

      a - Handling MFL in open containers.

4. Tools that have been exposed to MFL shall be cleaned by rinsing in C-714 or F-113 before reuse.

5. Contaminated clothing and protective equipment shall be cleaned under controlled conditions before being used again.

July 2, 1945

CARBIDE AND CARBON CHEMICALS CORP.
OAK RIDGE, TENN.

SAFETY BULLETIN S-6.

C-2144

PROPERTIES

Color	-	water-white when pure. gray-green after exposure to C-616.
Odor	-	odorless when pure.
Viscosity	-	16 to 25 centipoises @ 212° F. pours with difficulty at room temperature.
Molecular weight	-	950 to 1000
Density	-	16.7 lbs. per gallon.
Specific gravity	-	2.0
Boiling point	-	297° to 394° F. boiling range at 10 m.m. pressure.
Vapor pressure	-	less than 8×10^{-3} mm. at 140° F.
Solubility:		
C-714	-	soluble
Freon 113	-	soluble
C-816	-	soluble
C-716	-	soluble
Water	-	insoluble
Trichlorethylene	-	very slightly soluble.
Solvent action:		
C-616	-	C-616 is very soluble in C-2144. The solution has a high vapor pressure of C-616. (See Safety Bulletin S-1 for solubility table).
C-216	-	C-216 is very slightly soluble in C-2144,

C-2144 is a mixture of high molecular weight saturated fluorocarbons containing a very small percent of hydrogen. It is practically non-reactive with C-616 under operating conditions and is satisfactorily resistant to C-216 in concentrations less than 20% at operating temperatures. Higher concentrations of C-216 will react to form polymerized products. 30% C-216 will ignite C-2144 at elevated temperatures and will form explosive mixtures with C-2144 mist.

C-2144, as received, contains 1 to 2% dissolved HF.

USE

C-2144 is presently used as a vacuum pump oil in Valley Iron Works pumps and in all Stokes pumps except those on mobile C-616 units.

HAZARDS

1. The chief hazard in handling C-2144 results from the fact that it dissolves C-616 and the solution, when hot, has a high C-616 vapor pressure. C-2144 that has been exposed to C-616 will give off strong fumes and since the dissolved C-616 is protected from hydrolysis by C-2144, it will continue to fume for long periods of time. The fumes from C-616 dissolved in C-2144 present the same hazard as the escape of C-616 from process lines or equipment.

2. C-616 dissolved in C-2144 has the same corrosive action on the skin that C-616 or its hydrolysis products would have by themselves. Burns resulting from contact with C-2144 contaminated with C-616 are likely to be severe because the sticky nature of C-2144 tends to give intimate contact with the skin and its insolubility in water makes its removal difficult.

3. C-2144, when heated to the temperatures involved in welding, cutting or soldering, decomposes to form HF and other very toxic gaseous products.

PRECAUTIONS

1. As far as possible, C-2144 that has been exposed to C-616 should be handled in a closed system.

2. Exposure to C-2144 shall be avoided.

3. Protective equipment shall be used as follows:

   A. U. S. Army Assault Mask for:

      a - Opening equipment that contains C-2144 which has been exposed to C-616 or C-216.

      b - Welding or cutting lines or equipment that have contained C-2144.

   B. Neoprene gloves for:

      a - Handling C-2144 in open containers.

   C. Face shield for:

      a - Handling C-2144 in open containers.

4. Tools that have been exposed to C-2144 shall be cleaned by rinsing in C-714 or F-113 before re-use.

5. Contaminated clothing and protective equipment shall be cleaned under controlled conditions before being used again.

July 2, 1945

CARBIDE & CARBON CHEMICALS CORP.
OAK RIDGE, TENN.

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OFFICIAL USE ONLY

SAFETY BULLETIN S-5

H-216

PROPERTIES

Physical state - gas, liquid, solution in water, solution in catalyst.

Color - colorless

Odor - pungent, irritating, similar to HCl.

Molecular weight - 20.01

Melting point - -117° F.

Boiling point - 67° F.

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Specific gravity of liquid @ 65° F. - 0.988 (referred to water)

Specific gravity of gas @ 70° F. - 0.705 (referred to air)

Solubility:

Water - liquid is completely miscible, gas is very soluble.

H-216 is readily adsorbed onto porous surfaces.

H-216 solution in water is hydrofluoric acid, an extremely corrosive acid that attacks a wide range of substances including glass, leather, natural rubber and most organic materials. It corrodes some metals very rapidly, especially silica-bearing cast iron. Steel is satisfactorily resistant to the concentrated acid (greater than 60%), but is attacked by more dilute solutions.

H-216 forms the following compounds with adsorbent:

NaF·HF - solid
NaF·2HF - solid
NaF·3HF - liquid

These compounds give an appreciable vapor pressure of H-216. A similar series of compounds is formed with catalyst. The H-216 that is present in catalyst is combined in this kind of loose compound.

Gaseous H-216, when released in moist air, absorbs water to form a mist of tiny droplets of hydrofluoric acid.

HAZARDS

Burns

H-216 has an action limited to the surfaces which it touches. It tends to go into solution readily if the surfaces are moist, and a small amount of H-216 can produce a penetrating chemical burn over a volume of tissue which is out of proportion to the amount of acid involved. Such burns may be deceptive because the appearance of pain may be delayed for several hours, by which time a deep penetration of tissue may have occurred. H-216 burns are likely to occur in two ways:

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1 - Through contact with surfaces on which H-216 is present, such as:

a - Porous surfaces on which H-216 is adsorbed.
b - Moist surfaces on which H-216 is dissolved.
c - Solid catalyst or adsorbent in which H-216 is present as a loose compound.

2- Through exposure to H-216 gas or the mist formed when H-216 is released into a moist atmosphere. H-216 dissolves readily in a film of moisture on the skin and may cause widespread burns of comparatively slight intensity. Only persons wearing respiratory protection will be likely to experience this kind of burn since a concentration of H-216 gas or mist that will cause skin burns is intolerably irritating to the respiratory tract.

Respiratory Damage

H-216, when inhaled, dissolves in the moist lining of the respiratory tract and acts as an irritant. Dangerous concentrations of H-216 give ample warning by their strong odor and irritant action on the nasal passages and throat.

Toxicity

Minimum detectable by odor	3 p.p.m
Maximum allowable for prolonged exposure	3 p.p.m
Maximum allowable for exposures up to 30 min.	10 p.p.m
Dangerous for even short exposures	50 p.p.m

PRECAUTIONS

1 - Neither H-216 fumes nor H-216-bearing mists or dusts should be inhaled. Ventilation shall be used to clear contaminated areas.

2 - H-216 cylinders shall be handled with extreme care. The following are some specific precautions to be observed in their handling:

a - Cylinders shall be handled and stored so that the danger of mechanical damage to cylinders or valves shall be kept at a minimum.

b - Valve protective caps must be kept on cylinders except when cylinders are in use.

c - Never attempt to mix gases in an H-216 cylinder. Pressure gauges and other accessories provided for use with H-216 must not be used with other products and vice versa.

d - H-216 shall be handled only in cylinders which are approved for the purpose and properly identified.

e - H-216 cylinders shall be stored so that there is no danger of their being heated to elevated temperatures by sunlight, accidental fires, etc. No part of a cylinder should ever be subject to a temperature above 125° F.

f - Open cylinder valves slowly. Never use wrenches or tools except those specifically provided and approved for the job.

g - The 1" nut on commercial H-216 cylinders must be tightened and held tight while the valve is being opened.

3 - Before any connection on H-216 lines or equipment is broken, the lines or equipment shall be purged with G-74.

4 - All work on equipment containing H-216 or H-216-bearing materials shall be done in the vicinity of a safety shower.

5 - Tools used on equipment that has contained H-216 or H-216-bearing materials shall be thoroughly washed in soda ash solution and rinsed in tap water after each use.

6 - Protective equipment shall be used as follows:

A. U. S. Army Assault Mask.

a - Entering areas where breathing is restricted by H-216.

B. Self contained oxygen breathing apparatus.

a - Where there is an oxygen deficiency.
b - For rescue work in high concentrations of H-216 gas.

C. Air supplied hood.

a - Handling dusty H-216-bearing solids.

D. Face shield.

a - Operation of H-216 valves except through shields or barricades.
b - Handling H-216 cylinders.
c - Breaking connections in H-216 lines or equipment.

E. Gauntlet neoprene gloves.

a - Operations of H-216 valves except through shields or barricades.
b - Handling H-216-bearing solids.
c - Handling H-216 cylinders.
d - Breaking connections in H-216 lines or equipment.
e - Handling surfaces that have been exposed to H-216 or H-216-bearing materials.

F. Coveralls with legs and sleeves tightly closed at the cuff.

a - Handling dusty H-216-bearing solids.

G. Rubber shoes or boots.

a - Working in areas where the floor is contaminated with H-216 solution or H-216-bearing materials.

Note: The above material pertaining to protective equipment covers all anticipated exposures. In case of exposures not covered herein, the above information shall be used as a guide.

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OAK RIDGE, TENN.

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SAFETY BULLETIN S-4

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NO 30 OF 75 COPIES, SERIES A

C-816

PROPERTIES

C-816 is a completely fluorinated saturated fluorocarbon. When pure, it is a colorless liquid with a faint but distinctive odor.

Molecular Weight	-	400
Melting Point	-	-41.8° F.
Boiling Point @ 14.7 psia	-	216° F.
Density @ 60° F.	-	15.51 lbs./gal.
Specific Gravity @ 60° F.	-	1.865
Specific Gravity @ 165° F.	-	1.74
Solubility:		
Water	-	insoluble
Freon 113	-	slightly soluble
Halogenated solvents	-	soluble in traces only
Solvent Action:		
Fats	-	slightly soluble
C-616	-	soluble (17 mol % @ 60° F.)

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When heated in air to the temperatures involved in welding and cutting operations, it decomposes to form HF and other toxic gaseous products.

4% C-216, or more, in a mixture of gases, will form an explosive mixture with C-816 in any proportion. The mixture may, under certain conditions, explode spontaneously.

HAZARDS

1. C-816 vapor belongs to the less hazardous group of gases, but a high (1000 p.p.m.) concentration for a 30 minute exposure probably will produce irritation of lungs.

2. Welding or cutting metal that is wet with C-816 or exposed to C-816 vapors will result in the generation of extremely toxic gaseous products.

PRECAUTIONS

1. C-816 lines and equipment shall be emptied as completely as possible by draining or pumping, and then purging with dry air before maintenance work is begun.

2. Protective equipment shall be worn as follows:

U. S. Army Assault Mask for:

1. Exposure to high concentrations of C-816 vapor. (Mask will give protection for maximum of 30 minutes in such exposures).

2. Welding or cutting on lines or equipment which have contained C-816.

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Technical Information Officer Date
Oak Ridge K-25 Site

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CARBIDE & CARBON CHEMICALS CORP.
OAK RIDGE, TENN.

SAFETY BULLETIN S-3.

C-716

PROPERTIES

C-716 is a completely fluorinated saturated fluorocarbon. When pure, it is a colorless liquid with a faint but distinctive odor.

Molecular Weight	-	388
Melting Point	-	-70.6° F.
Boiling Point @ 14. 7 psia	-	180.5°F.
Density @ 60° F.	-	14.47 lbs./gal.
Specific Gravity @ 60° F.	-	1.735
Solubility:		
Water	-	insoluble
Freon 113	-	slightly soluble
Halogenated solvents	-	soluble in traces
Solvent Action:		
Fats	-	slightly soluble
C-616	-	soluble

When heated in air to the temperatures involved in welding and cutting operations, it decomposes to form HF and other toxic gaseous products.

C-716 forms an explosive mixture with C-216.

HAZARDS

1. C-716 vapor belongs to the less hazardous group of gases but a high (5000 p.p.m.) concentration for a 30 minute exposure probably will produce irritation of lungs.

2. Welding or cutting metal that is wet with C-716 or exposed to C-716 vapors will result in the generation of extremely toxic gaseous products.

PRECAUTIONS

1. C-716 lines and equipment shall be emptied as completely as possible by draining or pumping, and then purging with dry air before maintenance work is begun.

2. Protective equipment shall be worn as follows:

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2. Welding or cutting on lines or equipment which have contained C-716.

CARBIDE & CARBON CHEMICALS CORP.
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SAFETY BULLETIN S-2.

C-216

PROPERTIES

State in process - gas

Color - pale greenish - yellow

Odor - release accompanied by characteristic pungent odor somewhat similar to chlorine.

Molecular weight - 38

Boiling point - -307° F.

Freezing point - -369° F.

Specific gravity - 1.31 (referred to air)

Solubility - C-216 reacts with all of the common solvents, including water.

C-216 is the most powerful oxidixing agent known and will react with all organic and almost all inorganic substances under certain conditions. The only major classes of material that are completely resistant to the oxidizing action of C-216 are the pure inert gases and metallic fluorides in their highest valence state. The reactions of C-216 are usually accompanied by the evolution of a large amount of heat and elevation to high temperatures. In general the vigor of reaction is diminished by dilution of C-216 with air or nitrogen and increased by elevated temperatures.

Leakage of C-216 into moist air gives rise to the formation of white fog consisting of HF droplets formed by the reaction of C-216 with water vapor. The formation of this fog is dependent upon the relative humidity and may not appear during very dry weather. The yellow color of C-216 is not visible except in very high concentrations and large amount of gas.

Reactions

Material	Concentration of C-216	Temperature	Reaction
Water	100%	Normal	Vigorous, much heat, HF formed
Hydrogen	Wide range	Normal	Spontaneously explosive HF formed.
Organic - human flesh, wood, rubber, neoprene, cloth, oil, etc.	100%	Normal	Burst instantly into vigorous flame, HF formed. (Smooth neoprene surfaces, when perfectly clean, are resistant to reaction)
	50%	Normal	Rapid oxidation, HF formed, heat generated, flames if heat is not conducted away rapidly.
Inorganic - brick, concrete, stone, asbestos, etc.	60% to 100%	Normal	Instantly reaches incandescent temperature.
Metallic - steel, nickel, monel, copper, brass, alumium	100%	Normal	Slow, satisfactorily resistant.
	100%	300°F	Burst into flame, intense heat (heat to initiate reaction may come from oxidation of oil, water, etc.)
	60%	elevated	This is approximately the lower limit of concentration for vigorous reaction.
C-816 and C-716	-	-	Forms explosive mixtures.
C-2144 and M. F. L.	Greater than 6%	Operating	Forms polymerized products. Will burn in 100% C-216 under certain conditions. Forms explosive mixtures under certain conditions.
Poly TFE Plus CaF_2 (packing material)	100%	Operating temperatures	Normally satisfactorily resistant. Will burn under certain conditions.

1. Burns - A jet of C-216 from a pressure container will react with human flesh and can cause extremely severe burns that are very difficult to heal. Tissue destruction takes place in three separate ways:

(a) Destructive oxidation by C-216
(b) Thermal damage from the heat of reaction.
(c) Tissue poisoning by HF formed

All three types of damage occur very rapidly upon exposure to undiluted C-216 when impinged on a surface from a source under pressure. There is some degree of dilution below which the first and second do not take place to any significant extent but the exact value of this dilution has not been ascertained. The third type of damage takes place in much lower concentrations than the first two because HF is formed by the reaction of C-216 with moisture on the skin. HF is a protoplasmic poison with great penetrating power and causes deep-seated burns that heal very slowly.

When a jet of pure C-216 strikes most non-metallic materials, the surface of the material is instantly raised to an incandescent white heat. Personnel in the vicinity may be severely burned by heat radiated from the surface even when they are not directly exposed to C-216 at all.

2. Respiratory damage - C-216 is an irritant gas whose toxicity is approximately the same as that of phosgene. Exposure to dilute C-216 results immediately in irritation of the eyes, nasal passages, and throat. Next the skin becomes moist and then the front of the head begins to ache. The maximum allowable safe exposure occurs somewhere between the development of the last two symptoms.

Toxicity:

Minimum detectable by odor	3 p.p.m.
Maximum allowable for long exposure	3 p.p.m.
Immediately irritating (Tolerable for several minutes)	25 p.p.m
Intolerable even for short exposure	50 p.p.m

PRECAUTIONS

1. No protective equipment devised to date will give even temporary protection against direct exposure to a jet of undiluted C-216. Since this is true, all valves and equipment handling C-216 at pressures greater than two or three pounds should be operated, as far as possible, by extension handles through brick barricades or metal shields.

2. Openings into C-216 lines or equipment shall if possible, be sealed off from any possible source of C-216 pressure by two valves, preferably with a G-74 buffer zone between valves.

3. Before any equipment which has contained C-216 is disconnected it shall be vented and thoroughly purged with G-74.

4. Areas contaminated by a release of C-216 shall be evacuated of personnel immediately in accordance with the established evacuation procedure. No persons, except those wearing adequate protective equipment, shall re-enter the area until it has been completely freed of C-216 by thorough ventilation.

5. Protective equipment shall be worn a s follows:

A - Face shields for -

1- Operating pressured C-216 valves that are not protected by shields or barricades.

2- Disconnecting C-216 equipment except when a safety sample has been taken with negative results.

B - Gauntlet neoprene gloves (clean & presenting smooth surface)

1- For disconnecting C-216 equipment except when a safety sample has been taken with negative results.

2- For operating pressured C-216 valves not protected by shields or barricades.

C - U. S. Army Assault Mask for entering areas where breathing is restricted by C-216 (This mask not to be used where there is an oxygen deficiency).

D - Oxygen breathing apparatus for rescue work and all cases of oxygen deficiency.

6. No welding or other hot work shall be done on or adjacent to lines or equipment containing C-216.

7. The interior of all lines and equipment for handling C-216 should be perfectly clean and free from moisture, grease, or foreign material of any kind.

SAFETY BULLETIN NO. S-1

C-616

PROPERTIES

C-616 exists in three phases:

1- Colorless crystalline solid of high refraction
2- Colorless liquid
3- Colorless gas

The solid sublimes when heated at pressures below 22.0 psia, i.e., goes from the solid to the gas phase without passing through the liquid phase. The solid, when heated to 147.3° F. at pressures above 22.0 psia, melts to the liquid phase. (See fig. I). The liquid can exist only at elevated temperatures and pressures, and will flash to a gas immediately upon its release to atmospheric pressure through a leak or otherwise.

C-616 has the following physical properties:

Molecular weight - 352
Specific gravity @ 68° F. (solid) - 4.68
Density @ 68° F. (solid) - 292 lbs/ft.^{3}
Specific gravity @ 147.3° F. (liquid) - 3.67
Density @ 147.3° F (liquid) - 229 lbs/ft.^{3}
Solubility

1- Water -reacts, products soluble.
2- C-816 (solubility of solid C-616 at saturation vapor pressure.)

Temp. °F.	Lbs. C-616/gal C-816
-40	0.25
20	1.4
60	2.8
80	4.2
100	7.1
120	14.7
140	53.0

3. C-716 - No data available, but solubility presumably approximates that given above.

4. C-2144 -Solubility in pounds C-616 per gallon C-2144

Temp. °F.	Partial pressure C-616 (psia)					
	0.1	0.5	1.0	5.0	10.0	14.
80	.096	.53	1.18	25.0	>100	>100
100	.066	.35	.75	7.2	>100	>100
120	.046	.24	.50	3.4	16.0	>100
140	.032	.16	.33	2.0	5.9	17.
160	.023	.11	.23	1.3	3.3	6.
180	.016	.08	.16	.88	2.1	3.
200	.012	.06	.11	.62	1.4	2.

5. MFL - solubility in pounds C-616 per gallon MFL.

Temp. °F.	Partial pressure C-616 (psia)	
	1.5	3.0
100	1.30	3.08
120	0.83	1.96
140	0.58	1.22
160	0.42	0.85
180	0.29	0.63
200	0.20	0.45

6. Carbon tetrachloride - reacts, giving precipitate of T_4F_{18}, T_4F_{20} and gaseous products.

7. Trichlorethylene -Action is similar to that of CCl_4.

At operating temperatures C-616 is, to a small extent, reduced to TF_5, (a white solid), and to T_4F_{18} (a black solid) by its action on metals at operating temperatures.

C-616 and its solid hydrolysis products are radioactive and emit alpha, beta and gamma rays. The rate of disintegration, however, is much slower than that of radium and the energies of the particles emitted are different. Five grams of C-616 are equivalent to only 1 microgram ($\frac{1 \text{ gram}}{1{,}000{,}000}$) of radium with reference to the energy given off as radiation. There is, therefore, no danger from the radiation of this material except in the case of extremely large accumulations.

Hydrolysis Products

Upon contact with the atmosphere C-616 vapor is immediately hydrolyzed by the moisture present to form a dense white fog of TO_2F_2 particles and HF gas. Solid C-616 also reacts with the moisture content of the atmosphere to form TO_2F_2 and HF but the reaction is much slower. A crust of TO_2F_2 forms on the surface of the solid and tends to seal off the unreacted C-616 from the atmosphere.

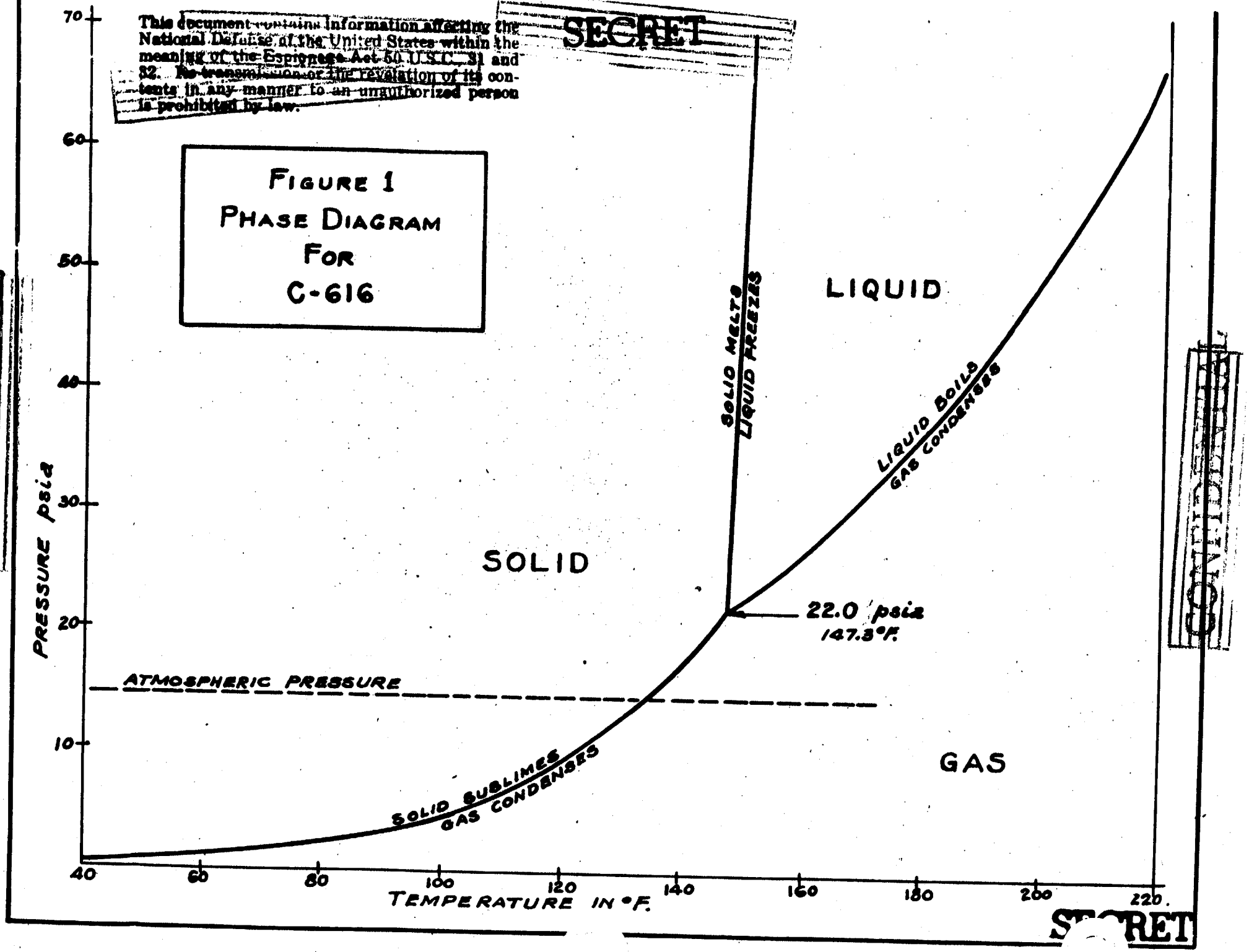
Upon contact with the atmosphere TF_5 and T_4F_{18} are also hydrolyzed by the moisture present to form green TF_4 and the two products mentioned above. The TF_4 is harmless because of its insolubility.

TO_2F_2 is yellow in the massive form but white in the finely divided dust or smoke form in which it is usually seen. This smoke, formed when C-616 vapor is acted upon by atmospheric moisture, is extremely persistent and very little of it will settle out in any reasonable length of time unless formed by the sudden release of large amount of material.

TO_2F_2 is very soluble in water and the solution is usually strongly acid. This acidity is largely due to the presence of HF adsorbed onto the TO_2F_2, but TO_2F_2 in the pure form, free of HF, forms a slightly acid solution.

HF is a colorless, strongly acid gas, soluble in water. It adsorbs readily onto surfaces which are exposed to it.

FIGURE 1
PHASE DIAGRAM FOR C-616



HAZARDS

The physiological action of the two components which make up the hydrolysis products varies somewhat, as shown below.

1. HF has an action limited to the surfaces which it touches. It tends to go into solution readily if surfaces are moist, and a small amount of HF can produce a penetrating chemical burn over a volume of tissue which is out of proportion to the amount of acid involved. Such burns may be deceptive because the appearance of pain may be delayed for several hours by which time a deep penetration of tissue may have occurred. These effects are less pronounced as a result of contact with mist of vapor than with liquid HF.

2. TO_2F_2 has an action both as a surface irritant and as a poisonous agent acting internally. On moist surfaces it has an action similar to HF but considerably less in degree. When inhaled as a fine dust or fume, it readily goes into solution on the moist linings of the respiratory tract from which it is readily absorbed. Of that which is swallowed, about 20% is abosrbed, the remainder passing through the alimentary canal without being absorbed. All of the TO_2 F_2 absorbed from any surface is eliminated by the kidneys, which causes kidney damage. However, evidence indicates that the effect of small quantities is not cumulative.

3. Exposure to hydrolyzed material must be considered as an exposure to the aggregate, rather than to the individual components. Exposures to dense concentrations of these materials in air have resulted in the following observances in clinical cases:

A. Burns of surface of eyes

B. Irritation of nose and throat

C. Superficial, transitory, first degree burns of exposed skin surfaces.

D. Irritation of the respiratory passages which may be followed by marked swelling of these surfaces (edema). Workers with severe cases of edema of the lungs may be critically ill and experience the following symptoms in a marked degree; cough, chest pain, shortness of breath and vomiting.

E. Characteristic kidney damage which is manifested by urinary changes, usually 24 - 48 hours after the exposure. Complete recovery from such damage occurs within a few days.

Victims who survive the respiratory damage mentioned in (D) have always recovered.

Persons exposed to lesser concentrations have the foregoing symptoms in gradually decreasing severity. Extremely light concentrations which are still dense enough to be seen or smelled are frequently experienced without any of the foregoing types of damage.

If hydrolysis products collect on the skin of the hands, and are subjected to pressure, heat and friction, as are experienced in the handling of contaminated tools, deep penetrating burns result.

As a safe limit of exposure to hydrolysis products in the atmosphere, it has been tentatively established that, for practical purposes, respiratory protection will be needed unless the atmosphere is clear and odorless. However, the maximum allowable exposure for T material is given in literature as 200 micrograms per cubic meter.

PRECAUTIONS

1. An area contaminated by the release of C-616 shall be evacuated of personnel immediately, and no one shall re-enter until it has been decontaminated except as provided below:

2. Protective equipment shall be used as follows:

A. U. S. Army Assault Mask - carried.
   (a) Working in areas where C-616 is at positive gage pressure.

B. U. S. Army Assault Mask - worn.
   (a) Opening equipment which contains or has contained C-616.

   (b) Entering contaminated atmosphere (where material may be seen or smelled).

   (c) When evolution of vapors occurs during decontamination.

C. Clearvue Dustfoe #2147 Respirator with #2148 filter - worn.
   (a) During decontamination operation (when atmosphere is not contaminated).

D. Coveralls (approved type)
   (a) Opening equipment which contains or has contained C-616.

   (b) Working in areas where C-616 is at positive gage pressure.

   (c) During decontamination operations.

   (d) Handling and transportation of contaminated equipment.

E. Gloves (neoprene or neoprene coated)
   (a) Handling surfaces which have been exposed to C-616.

   (b) Operation of C-616 valves under positive gage pressure (except where operated by means of extension handle through adequate barrier).

   (c) Handling of contaminated equipment, material or facilities used in their disposal.

F. Boots (rubber)
(a) During decontamination operations (if floor is contaminated).

3. Food, chewing tobacco, chewing gum, etc., shall not be brought into areas where it may be exposed to C-616.

4. Contaminated clothing and protective equipment shall be cleaned under controlled conditions before being used again.

5. Persons who have been exposed to C-616 shall take shower before leaving the work area.

May 31, 1945